Educational Beach Activities

Resource Notebook

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Abstract

This project is devoted to those involved in education. For the teachers, it is a resource of technique and information. For the students it is a stimulating learning experience interjected with motivational and scholastic skills. Furthermore, students will enter college armed with concepts and terms in marine sciences related to sediments. This project is an educational resource activity book about sediments designed to maximize learning retention. Implementing hands-on activities in the learning environment can bring out the enthusiasm and excitement of discovery, even àbout sediments.

I hear and I forget

I see and I remember

I do and I understand

- Old Chinese Proverb

Introduction

The mission of this project is to provide a resource notebook for educators, complete with information on the importance of hands-on activities in science, concepts about sediments and beach processes, simple complementary hands-on activities/experiments about those concepts, current issues, and additional educational resources (i.e. excursions.).

This project addresses the use of hands-on activities to enhance competence and understanding in science. In reference to the passage above, learning takes more than remembering; learning takes understanding! It is very important to instill understanding by involving the senses, reasoning, and establishing an interpersonal environment in the learning process (American Red Cross 1974). By incorporating hands-on activities in the classroom, and activating the use of senses, reasoning, and the environment, students can become successful learners .

Ultimately, to be effective, learning must engage the maximum number of senses (American Red Cross 1974). Schumm et al. (1994) recognize the diverse academic needs of students and the different types of teaching methods to suit these learners best. Each style involves the use of at least one stimulus. Some students may learn best by reading alone, some by listening alone, some by seeing alone, but most will learn and understand by doing.

I chose to develop an educational activity book about sediments and beach processes to provide teachers with a tool creative enough to encourage learning of this subject matter. Sediments and beach processes are important aspects that are only superficially covered in high school marine science curriculum. This is due to the fact that these topics are often of little interest to the students, or the teachers. K.C Cole (1990) suggest that the lack of interest may stem from the "suffocation of curiosity under an avalanche of fact" Merritts and Shane (1992) pointed out the failure to teach the excitement and thrill of doing science. Furthermore, educators themselves may have little knowledge of the subject matter (Haury and Rillero 1994, Kepler 1990) of sediments, and thus avoid it in the classroom.

The book I designed includes background information on different concepts involved in understanding sediments, and complementing exercises or activities corresponding to those concepts. The book may help to increase the number of successful learners entering the university system by providing educators with valuable background information and students with hands-on activities. Furthermore, the aim is to make the information to be learned understandable and not merely a reflection of what is memorized and recited. This is what makes an educational activity book important.

Utilizing new teaching methods in the classroom can be a joy for all students. Not only do teachers break their routine, but also their students, allowing students to see a different side of themselves as well as the teacher. More importantly they can see a different side of science. The side that brings about inquiry and discovery.

Hands-on activities were chosen as the focus of this educational resource for many reasons. One of the most important being that it is the primary way of establishing interest (Zahorick 1996). Achieving and maintaining interest of students is essential in order for them to learn. This interest is achieved by providing students with more than a text with words and pictures, but with the material itself. By allowing students to feel and work with sediments you capture another sense. It is the use of this additional sense that increases how much information is retained.

It is understood that knowledge is acquired by four modalities: visual, auditory, tactile, and kinesthetic (Schumm et al. 1994). Some authors in education may classify each one as a type or guild of learner. Simply, it is understood that individuals learn best by one of the four modals. However, to be successful learning must engage the maximum number of senses. Those who depend on tactile and kinesthetic learning usually rate as below average in school because they learn differently. Nonetheless, their learning capacity is equivalent or above those that may rank as average in the traditional mainstream curricula. This leads me to my next consideration for utilizing hands-on activities, learning retention.

It is also known that people can retain up to 10% of what is read, 20% for what is heard, 30% for what is seen, and an additional 20% for what is said (Pica 1997). Most importantly is that people can retain 90% of the information if it is read, seen, heard, said, and done. An old Chinese proverb says "when I hear, I forget, when I see, I remember, when I do, I understand.". This is the very point of this activity book, to get students to do so that they will understand.

So not only do hands-on activities capture the attention of students, but increases learning retention. Who wants to remember that gross picture of mud, when they can remember the ooze that runs between the fingers? In addition to retaining interest and attention, hands-on activities can bring about other skills.

The activity design can stimulate other important learning skills such as problem solving, decision making, and logical thinking. Equally important is the factual knowledge and scientific know how that students can gain. Each activity is complete with background information to supply factual knowledge. In addition the activities require an understanding of procedures which develops logical thinking and decision making (Freedman 1994). To conclude some activities are a series of questions pertaining to the information learned and background information provided. Students should be required to write out their results in order to maintain or further develop writing skills.

Other reasons that support using hands-on activities in the classroom include the loss of special programs outside of public schools due to budget cuts in education. These special programs are developed with the intention of enhancing learning by using hands-on activities. These programs use hands-on activities because they are the most effective means of educating others. Other benefits to these special programs are the specialist used to teach the topics. Often public school teachers may not be specialized in courses they teach. This brings about another challenge in developing the activity book.

The activity book must provide sufficient and essential background information for teachers to successfully teach the subject matter. If successful, teachers may note changes in students behavior towards increased participation, curiosity, and understanding. Ultimately students will be better prepared for college with new learning skills and a better understanding of science.

Background

Hands-on activities are the primary way of establishing interest (Zahorick 1996). The Waikiki Aquarium Blue-Water Marine Laboratory program has proven the effectiveness of hands-on activities. The subject matter becomes real and conceivable when more senses are used by students. Successful learning must engage the maximum number of senses (American Red Cross 1974); students learn and retain more by seeing, hearing, and doing.

Problem solving skills can also be acquired simply by having students set-up the activities (Freedman 1994). In 1993 the Leeward Community College Upward Bound Program required students to take their own data and develop their own computer presentation. Presentation style and skills require a lot of problem solving and decision making especially within a large group.

There have been other activity books related to marine science, especially in Hawai'i where the ocean is so prominent and connected to the students. Generally these books are directed at a specific age group, and briefly cover all aspects of marine science in little detail or concentrate on topics already of interest (i.e. marine mammals, biology of fishes, etc.). However, my resource book is specific to sediments and beach processes; a subject I find highly overlooked in high school marine science courses.

Sediments may be covered briefly enough to get the gist of what they are and where they come from. More importantly, however is to teach concepts such as settling and erosion. Teaching concepts that have applications towards ocean processes are exciting to explore and very educational as well. Furthermore understanding of sedimentology holds the key to many environmental issues about sea walls, beach erosion, and urban run-off effects on coral reefs.

Based on past experiences in teaching students about sediments in the Blue-Water Marine Laboratory, I noticed a transition of increased attention and motivation from my lecture to the actual process of sampling and experimenting.

Funds for the Blue-Water Marine Laboratory program have recently been suspended, and thus can no longer provide students around the state of Hawai'i hands-on learning aboard an actual research vessel. These activities must now be integrated into the classroom by teachers who may not be specialists. As government platforms change, so too will funding in education. These programs and many others may no longer be available for students to participate outside of the mainstream educational curriculum.

The use of hands-on activities has become a paradigm in education, but has been limited to special programs not accessible to everyone, and not incorporated into the mainstream educational systems. Kepler (1990) found that the biggest challenges in teaching were lack of science know-how, and lack of money. An elaborate resource activity book should provide enough science know-how and cheap methods to teach those concepts.

The intent of developing an activity resource notebook on sediments and beach processes is to provide an alternative curriculum which can be implemented in the classroom in elementary to high school levels. The purpose of using hands-on activities in the learning process is to stimulate interest (Tischler 1997), develop problem solving and decision making skills (Novelli 1995), and build understanding of related concepts. Sediments and beach processes are topics lightly covered and highly overlooked in high school. At the college level these subjects are difficult, but important aspects to understand. Utilizing hands-on activities is the surest way to develop each students understanding about these topics.

Methods

The information compiled came from an extensive review of other educational sources that have activities which can be further modified, or information about the effectiveness of hands-on activities in the learning process. Further review focused on beaches, coastal processes and issues, and sediments. The information was then compiled into a logical order. Background information was applied to the corresponding activities. The activities were designed to physically demonstrate different concepts, aspects, and topics of sediments and beach processes.

Results

Activities include collecting, sorting, identifying, classifying sediments, measuring, and observing shoreline movement. Most of the activities involve handling and looking at sand to provide that hands-on experience. Topics include properties of sediments such as turbidity, cohesion, porosity, and settling.

There are many other educational resources that provide activities related to marine science. Many involve coloring of anatomy, or things to do at the beach. Instead, this activity book brings what you may see at the beach into the classroom (where most learning takes place). The activities encourage students to grasp problem solving/decision making skills, logical thinking, and enhanced knowledge of subject matter. More importantly, this book challenges students to question and make connections to other ideas and concepts in the real world.

The purpose of developing an educational activity book is to provide teachers with a resource to implement into their mainstream curriculum. The use of hands-on activities in education secures scientific know-how, problem solving skills, and understanding. If more teachers were to use this and similar resources there might be an increased amount of students entering the university system. More importantly is that students will enter the university better prepared with the understanding to take on the "avalanche of facts" (Cole 1990).

The results of this project is an activity book located in appendix i.

Summary

Unfortunately, the results were not implemented into the actual classroom. However, many have been practiced in different forms, although without the written form. All that is documented is not totally unique, and each can be altered in many ways by the educator to suit his or her needs. It is my hopes that these activities be implemented with much criticism. The goal was to provide a resource that would encourage hands-on activities in the learning environment. As each activity is practiced over and over the procedures become easier presented and understood.

Appendix i

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Educational Sediment Activity

Resource Notebook

by Kevin Baptiste

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Introduction

Students are fascinated by objects they can see, touch, and smell. This book is developed with the thought that utilizing these senses will enhance the learning process.

Teachers are confronted with the challenge of maintaining the interest of their students. However, traditional teaching methods may not be as effective in retaining the interest of students. Instead, teachers should utilize new teaching methods such as hands-on activities to bring about understanding.

Hands-on activities are one method of active learning. From role playing to building blocks, hands-on activities begins early in any child's development. The mainstream curricula takes active learning away as early as the age of nine, and focuses education and learning on reading and listening comprehension. This activity book is an attempt to bring back active learning in the classroom, where most learning takes place.

As a marine science major, I realized the related importance of sediments to the chemical, physical, and biological aspects of the marine environment. However, the importance was not evident until college education. One goal of this project is to highlight the importance of sediments to students at a younger age.

Due to the content and subject matter, the book is intended for generally high school aged students however a few activities may be understandable by younger students. Some of the activities should be able to generate interest and curiosity in students of all ages.

About the Activities

Activities will include collecting, sorting, identifying, observing erosion processes, and classifying sediments. Topics in the activities will include properties of sediments such as turbidity, cohesion, porosity, and settling. Effectively arming students with these concepts will bring about a better understanding of sediments.

Each activity begins with an objective section. It describes the purpose and goals of the activity. In it you will run across terms related to marine sediments. These terms can be found in the glossary for a more complete explanation and understanding. In addition, a methods section is included to describe and explain the method of sampling.

The next section is the background. It is very important to understand this section and retain the information given. This section is also full of terms related to sediments. More importantly, is understanding the processes explained in this section. The purpose is to provide essential background information and to provide updated paradigms about marine sediments. In addition, information is provided to reveal connections between sediments and the chemical, physical, and biological aspects of the marine environment.

You will also need materials for the activities themselves. Most of these activities were developed with the thought that the activity needed to provide cheap alternatives. Sometimes money can become a teaching issue. Although the activities may require extra spending the effects are worth its cost. When applicable, the activity will have a page or two on making your own supplies to defer costs, this can be an educational activity within itself. You may also need to take another extra step and collect sediments yourself to provide for your students. Often this requires having samples from multiple sites. You can offer your students extra credit if they bring in their own. If possible, collect sediments on field excursions to the beach for other activities. Other equipment may need to come from your lab supplies.

In the procedure section you will find a step-by-step layout on conducting the activity. Steps will include the use of the data sheet for observations and information. Also steps required to complete the activity. At the end you may find an extension section which makes the activity applicable towards other topics, and may give you ideas to apply the activity in other aspects of marine science.

Finally, students should use data sheets to keep a record of their results and record any observations or further analysis of the activity. The data sheet may also be used to present group data before their peers.

In order for hands-on activities to be effective for everyone; each individual must become a participant. This will require dividing the classroom into several groups. Some activities require smaller groups than other activities. If available, assistants become valuable assets in monitoring many groups. However, the difficulty of tasks should not engulf the high school student. In each group students will be assigned certain tasks if procedures are repeated than each student may rotate their tasks for the activity.

Exploring Classification Schemes of Sediments

The challenge of this section is to develop an understanding of the physical characteristics and dynamics of sediments settling to the seafloor in order to conceptualize the many classification schemes that exist for sediments.

Sediments are an accumulation of unconsolidated particles. They are important in determining biogeochemical processes in the worlds oceans, and recording past oceanic conditions. First of all they are found throughout the whole world ocean seafloor. Therefore, they constitute a major reservoir of chemicals regulating the chemical composition of seawater. Before investigating the chemical and historical aspects of sediments, we must come to an understanding of their sources and distribution.

Sometimes it is easy to look at sediments on a large scale level of distribution. They can either be Neritic or Oceanic (pelagic). Sediments that settle on the continental shelf or nearshore are characterized by fast accumulation rates and usually transported out onto the shelf by river mouth deltas and distributaries, glaciers, and turbidity currents. These fast modes of transport result in unsorted deposits. Over time, constant levels of disturbance may result in sorting in isolated areas.

Generally, pelagic sediments are transported by low energy mechanisms resulting in very small and fine sized, well-sorted particles. Sediments transported by wind (aeolian transport) out into the open ocean fall under the influence of their own physical features. Their settling rate is a function of their size and shapes resistance to friction and buoyancy under the force of gravity. Turbidity currents carry sediment loads across the continental margins, and as they lose their energy they deposit sediments onto the open ocean basins.

Sorting Sediments by Size

OBJECTIVE:

To describe characteristics of different size particles relative to one another and to determine any correlation of features and sizes. To derive inference about size and physical aspects constituting the specific features of sediment particles (i.e. wave activity).

METHOD:

Students will sort and weigh samples of different sizes. Furthermore, they will need to develop a list of characteristics for each size (smooth, round, flat, etc.). Students will be able to hypothesize about settling patterns of different sized particles.

BACKGROUND:

Sediments have distinct settling characteristics as determined by a function of size. Wentworth (1922) developed a size classification naming different particles for various diameter size ranges. The largest being boulder and the smallest is a colloid. The more relatively important sizes, with regards to our experiment, may be sand, silt, and clays; they are further divided within themselves into coarse, medium, fine, and very fine sizes.

MATERIALS:

Sediment Sieves (can be made, see attached)

Sediment Sample

Balance or Volumetric Cylinders (500 ml)

PROCEDURE:

1) Use balance or volumetric cylinder to determine initial volume of sediments. If volumetric cylinder is used remember that volume is determined by displacement of water. Label I

2) Sieve sample into at least three size groups.

3) Reweigh or volumetrically measure each size range. Label each C, M, F, VF

4) Determine percent of each size to whole sample.

   %C = (I-C) / I, %M = (I-M) / I, etc.

Building Your Own Sand Sieve

MATERIALS

3-6 containers (Cool whip, butter bowls, paper bowls)

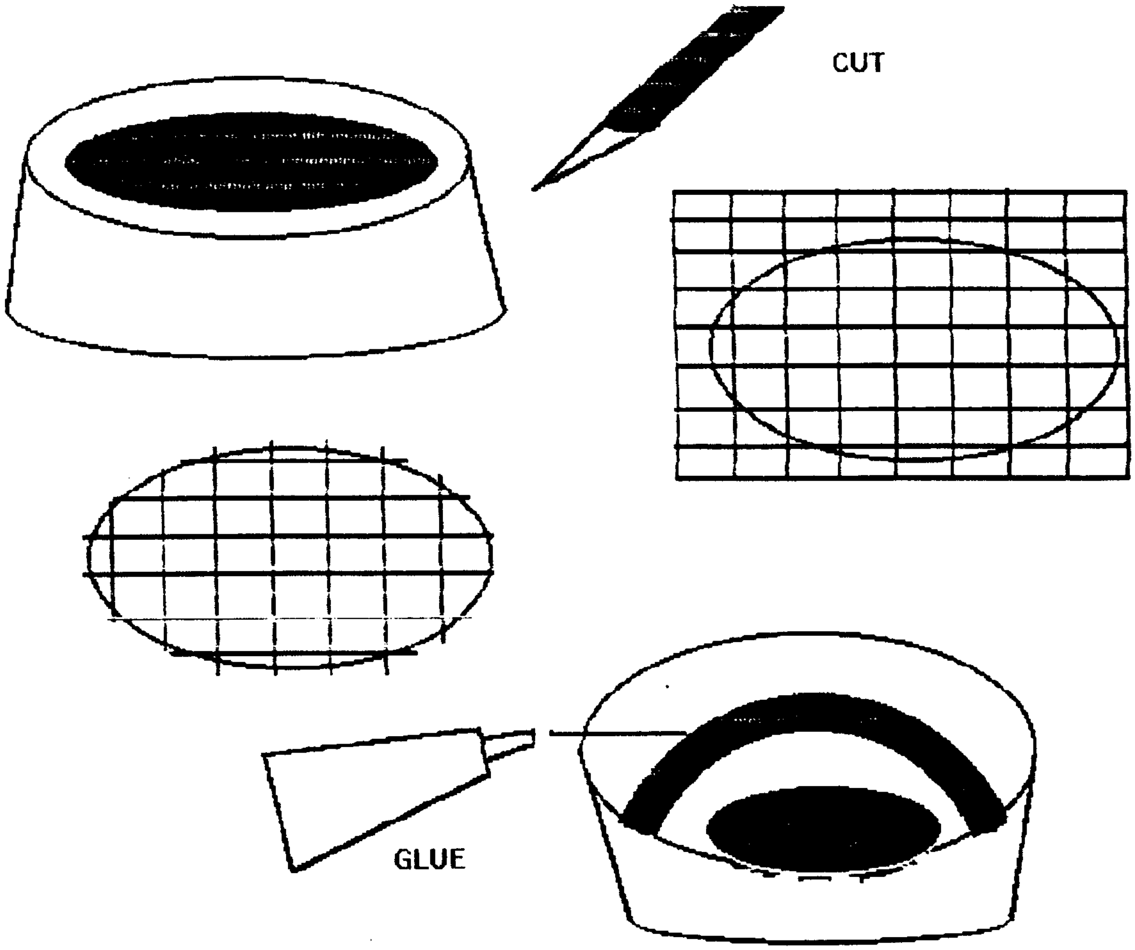
3 meshes (screens, netting, or chicken wire)

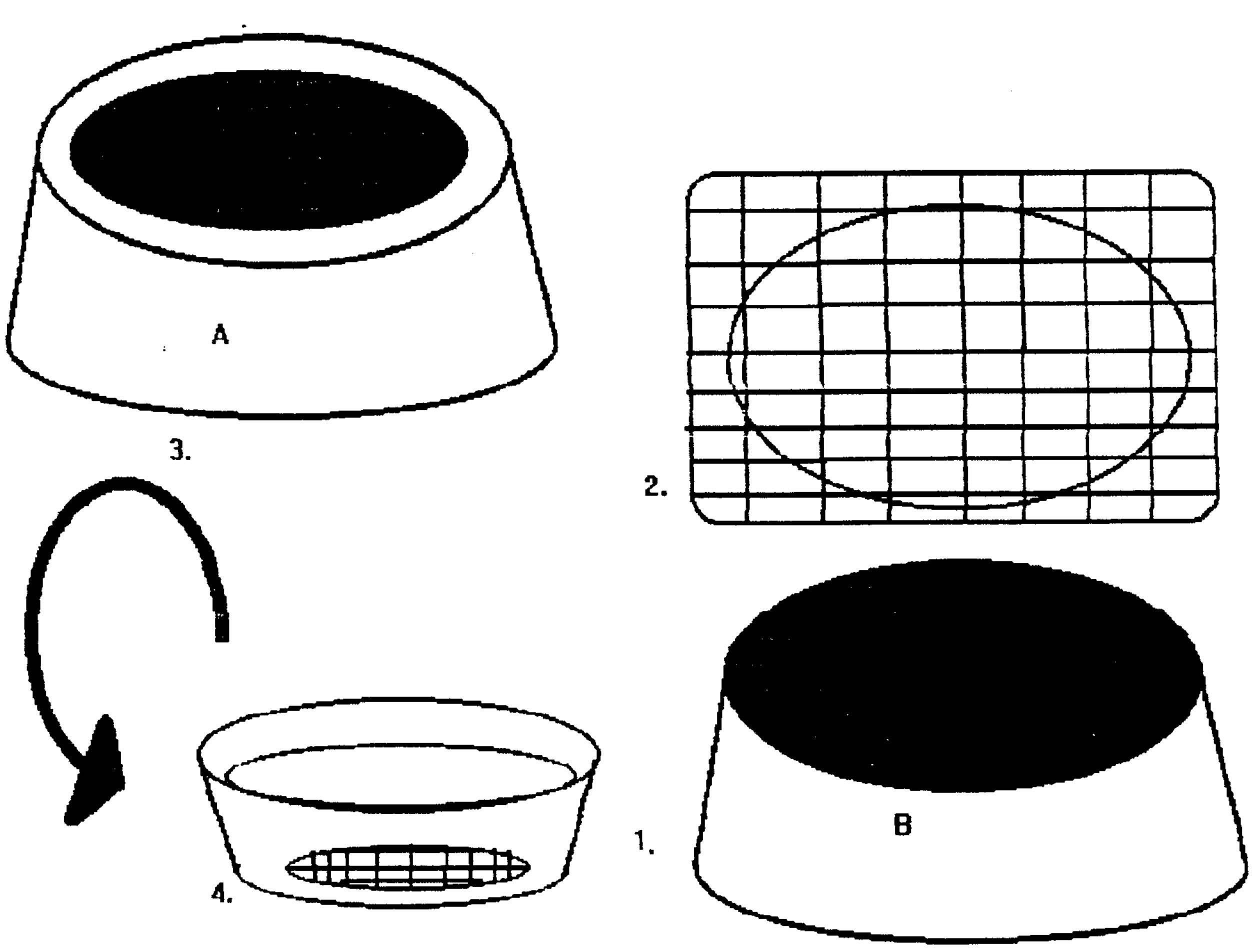
different sizes from 1/2" coarse, 1/4 medium, 1/8 fine; or smaller

waterproof epoxy

PROCEDURES

1. Cut holes in the bottom of container. If two bowls per sieve are used cut the whole bottom out of one (outer) and partial for the other container (inner).
2. Place container over meshing and cut meshing larger than the bottom.
3. Glue meshing from the inside. If two containers are being used simply place meshing over the bottom and trap it between with the other container.
4. Label sieves according to size.


CUT
GLUE


A
3.
2.
B
1.
4.

Settling of Sediments

OBJECTIVE:

To determine settling rate of sediments and sorting patterns. To derive inference about settling rates based on grain sizes

METHOD:

Students will take a height measurement of sediments settling over time in a column of water and draw a graph representing the view of the settling properties.

BACKGROUND:

Understanding that size plays a major role in settling and distribution of sediments we will investigate the time it takes for a sample to settle. Settling is significant in measuring turbidity (clarity of the water). Suspended particles can prevent the suns light (the source of energy for living organisms) from penetrating through surface waters.

Settling patterns may also be indicators of disturbance or changed energy levels in an area. Ironically it takes the same amount of energy to move boulder, cobbles, and pebbles, as it does to move clay, but less to move sand. The cohesion of clay makes it difficult to lift from the surface. The energy required may be equivalent to the energy needed to move pebbles, cobbles, and boulders. Sand, however, is less cohesive and has lower frictional energy, thus is easily carried away. Futhermore it takes more energy to suspend and move particles from the bottom than it does to move already suspended particles of the same size.

MATERIALS:

Sediment sample (various sized particles works well)

Clear cylinder (500 ml) easy to cover and shake

Ruler & Timer (seconds)

PROCEDURE:

1. Students will note various sizes, this may be used in conjunction with sorting experiment.
2. They will place sand into cylinder and measure height.
3. Fill cylinder with water.
4. Cover and stir well by flipping upside down and over several times. Be sure to get all of the sediments mixed.
5. Place right side up and begin timing.
6. Take height measurements of settled sediments at timed intervals. Most settling occurs early on so take short intervals at first, every 10 or 30 seconds. After several minutes increase intervals to minutes.
7. Note observations in clarity of water above, and settling patterns.
8. Make a graph representing time in the x-axis, and height in the y-axis.

Determining Composition of Sediments

OBJECTIVE:

To determine the percentage of biogenous and terrigenous sediments. To derive inference about the composition of biogenous sediments and age of area, or other sources of biogenous or terrigenous sediments.

METHOD:

Students will volumetrically weigh a sample then decompose chemically all biogenic sediments then reweigh to determine percentages.

BACKGROUND:

A classification scheme, sometimes more important to the chemical aspects, can be based on the source of the sediments. There are lithogenous (terrigenous) sediments which come from weathering of continental rocks, and basalts. Biogenous sediments come from the hard parts of living organisms. Generally they are forms of calcium carbonate or silica. Hydrogenous sediments are composites of metallic minerals that are precipitated out of sea water and formed in situ due to coexisting physical and chemical environments. An example is a manganese nodule. There are also cosmogenic sediments which are tektites, particles form space, that come hurling through the atmosphere landing throughout the earth. Finally, some may argue a human source of sediments, usually pollutants, that can be called anthropogenic sediments.

The proportions to which these types of sediments exist vary as a function of their rate of supply from their source, and disturbance contributing to erosion and deposition.

These ratios vary according to the most dominant source. Though river runoff may contribute high amounts of terrigenous sediments, high wave activity may fracture and/or carry biogenous sediments from other sources. Similarly, periodicity of volcanic activity may contribute to a sample dominated by terrigenous sediments.

Sediments are valuable indicators of the overlying waters and surrounding benthos. Investigating the biological components can reveal interactions in the food web and physical disturbances.

MATERIALS:

Sediment sample (of known source)

Use different sources for different groups (i.e. near river)

Graduated cylinders (10 & 50 ml)

Erlenmeyer flask (100 ml)

HCL hydrochloric acid 10%, or vinegar (takes very long)

Mortar and Pestle (optional)

Sea water to neutralize HCL from skin irritations

PROCEDURES:

1) Describe the appearance of original sample. Estimate percentage of biogenous vs. terrigenous sediments.
2) Grind sample if it is coarse with mortar and pestle.
3) Fill 50 ml graduated cylinder to 25 ml with water.

4) Pour dry sample sediment into cylinder with water until meniscus is at 50. Now you have 25 ml of sediments. Indicate this value as (I). Smaller sample may be used to shorten the amount of time.
5) Pour sediment sample into Erlenmeyer flask and drain water.
6) Add 10 ml of HCL at a time.
7) Note and record observations. Record how much HCL is used and what the acid doing to the sediments.
8) Repeat step 6 until most of the reaction stops.
9) Pour out the remaining sediment sample, and compare to the original.
10) Note appearance of remaining sediment sample, and compare to the original.
11) Refill 50 ml to 25 ml with water, if your final sample is small use 10 ml graduated cylinder and fill to 5 ml or less.
12) Pour your final sample into graduated cylinder with 5 ml of water and measure difference of ml increased. Record your results as (T).
13) To calculate your biogenous volume subtract T from I (I-T). Record as (B).
14) Calculate percentage B/I x 100 = % biogenous, T/I x 100 = % terrigenous.
15) Compare your test results to other groups. How does there initial and final sample look?
16) Hypothesize for any differences (i.e. more terrigenous = river, no organisms).
17) Investigate area of source of sediments (reef?, stream?, beach? Etc.).

EXTENSIONS:

In the background presentation you may include the fact that you are investigating a segment of the food chain. Therefore your findings may be indicators of the environmental conditions, and the interactions that occur between organisms and the environment.

In addition to visually attempting to determine the percent composition of sediments, it may be good to describe the wet sample by color, smell, texture. This involves the use of more senses in order to stimulate curiosity.

Before beginning the experiment it may be helpful to grind the sediment if there are large pieces. This requires a mortar and pestle.

QUESTIONS AND ANALYSIS:

Define and list on example for the following

Biogenous sediments

Terrigenous sediments

Where would you find each type of sediment? (hint: what is the source)

What was the Hydrochloric Acid (HCL) used for?

What was the observed reaction when HCL was added?

What gas was released during the reaction? How do you know?

Determining Composition
Data Sheet

Name____________

Where was your sample collected

When was your sample collected

Describe your sample by using color, texture, and smell etc..

Visually estimate the percentage of Biogenous and Terrigenous sediments. (hint: light and dark sediments)

How much ml of HCL was used to complete your reaction

Fill the Data Table

Total Volume (I) - Final Volume (T) = Dissolved Volume (B)

Percent = B x 100/(I)

What conclusions can you draw about recency of volcanic activity, age of island, or biologic activity?

Define and list one example for Biogenous and Terrigenous sediments.

Where would you find each type of sediment? (hint: what is the source)

What was the Hydrochloric Acid (HCL) used for?

What was the observed reaction when HCL was added?

What gas was released during the reaction? How do you know?

Visually Determining Composition of Sediments

OBJECTIVE:

To visually investigate biogenic, and lithogenic components by identifying sediments.

METHOD:

Visually determine percentages of biogenous and terrigenous sediments by using a microscope and grid etched petri-dish.

BACKGROUND:

The composition of sediments can be determined in several ways. Visual composition has advantages over chemically determining its composition. For example one may prefer to determine the ratio of a specific organism to another in the sediments. This gives valuable information about the surrounding environment with respect to competition. Unlike chemically separating the biogenous components from terrigenous, this activities allows you to identify different organisms and there ratio as a biogenic group.

MATERIALS:

Microscopes (dissecting)

Sediment Samples

Grid Etched petri-dish

Identification Key of sediment particles

PROCEDURE:

1) Count number of whole squares on petri-dish.
2) Pour sediment from sample and distribute evenly.
3) Examine on microscope, any ten squares and take separate data for each square.
4) Count number of terrigenous, and biogenous particles for first square and write data down, continue for 2-10 squares.
5) Add all of the terrigenous samples and divide by number of squares chosen (eg. 10) to find average. Repeat for biogenous sediments and record data as an average.
6) Add both terrigenous and biogenous particles average to find total. Write as total.
7) To find the percentage divide average of terrigenous by total. Repeat for biogenous and record data (illustrate as a percentage graph).
8) Count different biogenous components for each square, and identify individually as species. For unknowns classify as other.
9) Find average of each organism by counting total and dividing by number of squares used.
10) Divide the average of biogenous sediments by the total for each species and times by a hundred to get percentage of each species (illustrate as a graph for biogenous sediments only).

Identifying Sediments

One of the most interesting things about Biogenic sediments is analyzing its components. Sand is composed of the many organisms that live just beyond the shore. What is left is the organisms hard parts.

One group is composed of calcium carbonate (CaCo3). The most abundant and widely distributed are found on the microscopic level. These are foraminifera's (single-celled animals), and cocolithophores (single-celled plants). Other carbonates include invertebrate shells (external skeletons), and fish bones.

The other group are called silicates because of their siliceous skeletons. This group includes diatoms, radiolarians, flagellates, and sponges. Diatoms are also single-celled plants. Their skeletons are called frustrules and are found in both planktonic and benthonic areas. Radiolarians are single-celled planktonic animals, and flagellates are considered both animal and plant because it has the capability of obtaining energy in both fashions.

What was I?

OBJECTIVES:

Students will investigate the components of sediments (sand) and determine the source of different particles by corresponding fragments to the whole organism or structure

METHOD:

Using pictures of whole organisms and actual fragments, students must match the fragments to the whole organism.

BACKGROUND:

Sediments (sand) is made up of many different things that are fragments of larger organisms or even whole organisms in itself. The change in appearance is related to many physical processes. Erosion can transport fragments form the offshore reef to the sandy shoreline.

Many of the fragments come from organisms that have a Calcium Carbonate structure. Some organisms,, like humans, have internal bones; other organisms such as many invertebrates have external hard structures (e.g. shells). Crabs and lobsters often molt their shell, leaving behind an empty structure exposed to the waves. Continuous disturbance breaks the shell into smaller and smaller fragments over time. The continued wave action carries the fragments (sediments) closer and closer to shore. Eventually it will end up onshore exposed to wind (aeolian transport).

Similarly, hermit crabs may abandon their external shells from snails (mollusca) for a new one as they grow larger. Whatever the example may be these fragments are made from some type of calcium carbonate structure. Sediments that are formed from a byproduct of an organism are termed biogenic sediments; Biogenic sediment are characterized by their whitish appearance or light color

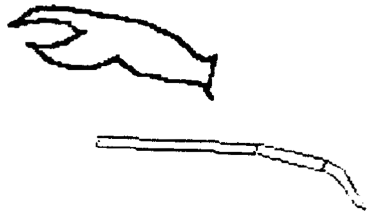
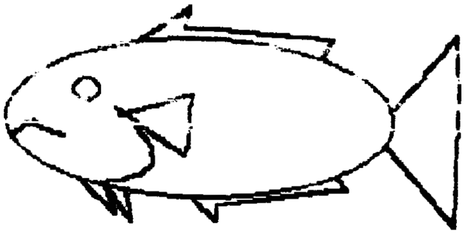
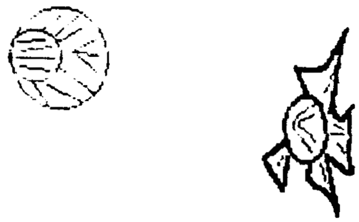
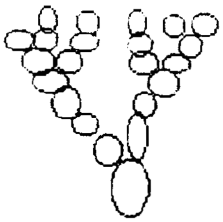
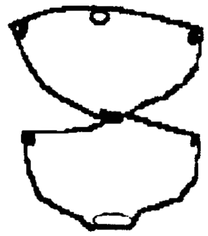
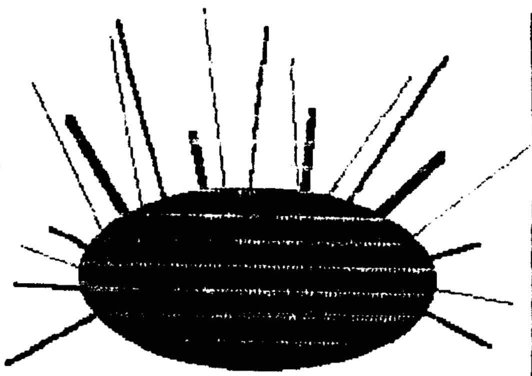
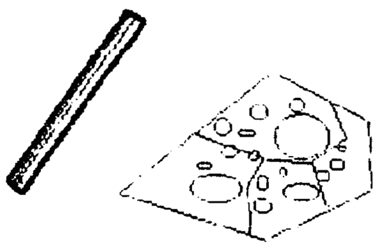
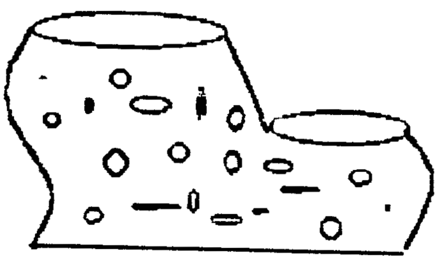
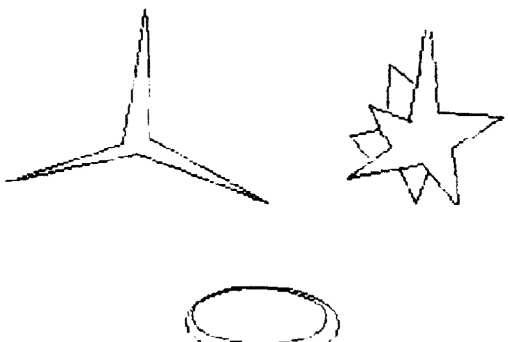
MATERIALS:

Large collection of sand (sediments); preferably coarse fragments

Identification cards of different organisms composing the sediments.

PROCEDURES:

1) Xerox and cut out copies of organisms parts and whole. You may want to color coordinate parts from the whole organisms.
2) Pass out cards randomly to each student. Allow some students to dig in an actual sample for some fragments.
3) Allow students to pair up and guess which is their other half.

Scavenger Hunt

OBJECTIVE:

To have students explore the sandy shore for organisms that constitute the bulk of the sand. To inquire about clues relating the source of sediments.

METHOD:

Allow student to sort through the sand and pick out sediments that look curious to them that they may have questions or may want to keep in a slide.

BACKGROUND:

The shoreline is composed of many things both biotic and abiotic. Biogenic sediments are predominant in Hawaiian shorelines. They are characterized by their pale color and growth patterns. Parts of virtually every family of marine organisms eventually end up in the sediments. Allowing students to search and discover for themselves what is in sediments (sand) can be fascinating.

Terrigenous sediments are generally easy to distinguish from biogenous sediments. They are generally dark in color (black) in Hawaii. Black basalt also forms olivine crystals which are translucent green in color. Although it is not as fascinating to discover as biogenous sediments, they are present and cannot be overlooked. .

MATERIALS:

several large tubs or buckets

lots of sand to fill the containers

identification keys

Dissecting Scope if available

PROCEDURES:

1. Present students with a tub full of sand
2. Have them sort and pick out several items
3. Ask them to describe it and hypothesis what it is or what it is from.
4. See if they can group the items into categories based on general observations.
5. Give groups the opportunity to discuss between each other
6. Discuss with them what it is
7. You may decide to group them by plant or animals, and unknown. Try other options like specific animal groups such as Mollusca, or arthropods.
8. After discussion allow them to sort through identification keys to verify their hypothesis.
9. Allow students to investigate their items further with the microscope
10. Ask them to draw the grain large and share with the class. Be sure to share classification and composition.

EXTENSIONS:

Place litter in tubs of sand and have students find things other than sediments. The idea is to portrait litter and beach drift.

Making a Slide

OBJECTIVE:

To create a slide of micromollusc and other organisms, in order to develop classification, and identification skills.

METHOD:

Students will collect microorganisms out of sediment same which they would like to keep and glue them to a frame.

BACKGROUND:

One good way of evaluating a sediment sample is keeping a record of its components. The best way instead of a written record is to keep a visual guide. You can do this by creating a slide with a key. This will help to keep a record of the different organisms found in a sample. Identifying sediments (microorganisms) can be done using sediment key guides, or micromollusc guides. The purpose is to develop morphology recognition. Looking for patterns may help to remember different organisms.

MATERIALS:

Poster Boards

slide frames "optional"

clear plastic report covers

glue (Elmer)

toothpicks

PROCEDURE:

1. Collect individual specimens. (Approximately 20)
2. Draw a grid on a poster board base. Be sure to label the x and y-axis
3. Glue specimens in each grid. Use toothpicks to dab glue on poster board.
4. Glue and Place one or two slide frames (cut out poster boards) atop the base.
5. Glue and Place clear plastic on top.
6. Cover plastic with another frame.
7. On a sheet of paper write a key or guide to the slide using the axis labels.
8. Identify the sediments and label accordingly.

EXTENSIONS:

Alternatively, they can simply glue a whole sample of sand to an index card with the place name of the sample. If possibly have them identify and label on their card different plants or animal parts.

Beach Processes

In this section you will discover the many physical aspects related to marine sediments that shape our shorelines. Erosion is simply the transport of material. Different physical properties of the water control where and how much sediment is transported.

The beach is considered to include the sand and sediment lying along the shore, exposed to waves and currents that reallocate the sediments. From inland to seaward the beach consist of many well defined regions.

First is the coast; it may have a well vegetated upland with a boundary demarcated by the debris line. The backshore includes berms, crests, and scarps. These are defined by seasonal changes. The foreshore includes the beach face and low-water shoreline. This are is the most heavily affected by waves and changing tides, because of its exposure underwater. Offshore you will find sand bars that disappear and reappear throughout the year. This is evidence that sand migrates back and forth from the shoreline.

Shoreline Movement

OBJECTIVE:

To record observation information of shoreline regression.

METHOD:

Students will create a shoreline in a pan with water and generate waves to observe shoreline movement.

BACKGROUND:

Although erosion upland is extensive, and you would expect the beach to be larger than it really is, shoreline transport keep the beach relatively stable. The usually changing beach may in fact be balanced between material that comes in and material that is removed. Changes may be influenced by seasonal changes in wave dynamics. Onshore transport carries suspended sediment toward the shore. Where as, longshore currents transports sediments away and down the beach.

MATERIALS:

Large flat deep pan (disposable 9" x 13" baking pans work good)

Lots of sand

Water

toothpicks

PROCEDURE:

1. Fill one side of the pan with mound of sand to represent a shoreline.
2. Gently fill in the pan half way with water or to half of the height of the shoreline.
3. Use toothpicks to mark the current sea level on the sand
4. Gently generate waves perpendicular to the shoreline for an extended period.
5. Record observations of the shoreline relative to the toothpicks. Also any changes to the "sea surface". Has sand extended out away from shore?
6. Rebuild your sand mound and try waves of different angles and strengths.

EXTENTIONS:

Use a clear wave tank to do the same. This gives a better perspective of the motion of sand with different force waves. Build a sand bar and observe changes to the waves. You can also trace the vertical profile of the shoreline before and after wave erosion.

Glossary

Authigenic: Sediments deposited or redeposited originating from the locality in which they are found.

Basalt: Black igneous rock that solidifies from magma. Chemically it contains mostly magnesium and iron silicates.

Beach: Zone of unconsolidated material between the mean low-water line and the line of permanent vegetation, which is also the effective limit of storm waves; sometimes includes the material moving in offshore, onshore, and longshore transport.

Benthic (Benthos): Pertaining to the bottom seafloor and the organisms living there.

Biogenic: Sediments composed of the remains of plant and animal life, such as shells.

Bioturbation: Reworking of sediments by organisms that burrow and ingest them.

Calcareous: Containing or composed of calcium carbonate.

Calcium Carbonate Compensation Depth: The level in the ocean below which calcium carbonate shells dissolve back into sea water faster than they rain down from above.

Clay: Hydrated rock composed of plate-like sheets of potassium, calcium and sodium silicate with water chemically bound between the plates.

Coccolithophore: Microscopic, planktonic algae surrounded by a cell wall with embedded calcareous plates.

Cohesion: Molecular force between particles within a substance that acts to unite them.

Cosmogenous: Sediment particles with an origin in outer space.

Dinoflagellate: One class of planktonic organisms possessing characteristics of both plants and animals.

Eolian: Pertaining to wind-blown sediments

Erosion: Process of transporting sediments

Foraminifera: Calcium-carbonate secreting microorganisms that live in the surface waters of the oceans; after death their shells form the primary constituents of limestone rock and sediments deposited on the sea floor.

Frustule: Siliceous external shell of a diatom.

Hydrogenous: Pertaining to sedimentary deposits from the water column; formed in situ.

Igneous rock: Rock formed by congealing rapidly or slowly from molten magma.

Infauna: Organisms that live buried in the sediment

Longshore transport: movement of sediment by the longshore current.

Manganese nodules: Accretions from the water column of manganese and other precious metals at the sea floor in the form of rounded nodules. The ultimate source for metals is the black smoker system associated with spreading ridges.

Nannofossils: Tiny calcareous shelled microfossils.

Olivine: A magnesium iron silicate mineral that is the primary constituent of the mantle.

Permeability: The ability to transfer fluid through cracks, pores, and interconnected spaces within a rock.

Porosity: The percent of a rock consisting of pore spaces between crystals and grains, usually filled with water.

Radiolaria: Siliceous-shelled microorganisms whose shells make up a large component of siliceous sediments.

Sediments: Particulate organic and inorganic matter that accumulates in loose, unconsolidated form.

Siliceous: Sediments composed primarily of quartz and other forms of SiO2.

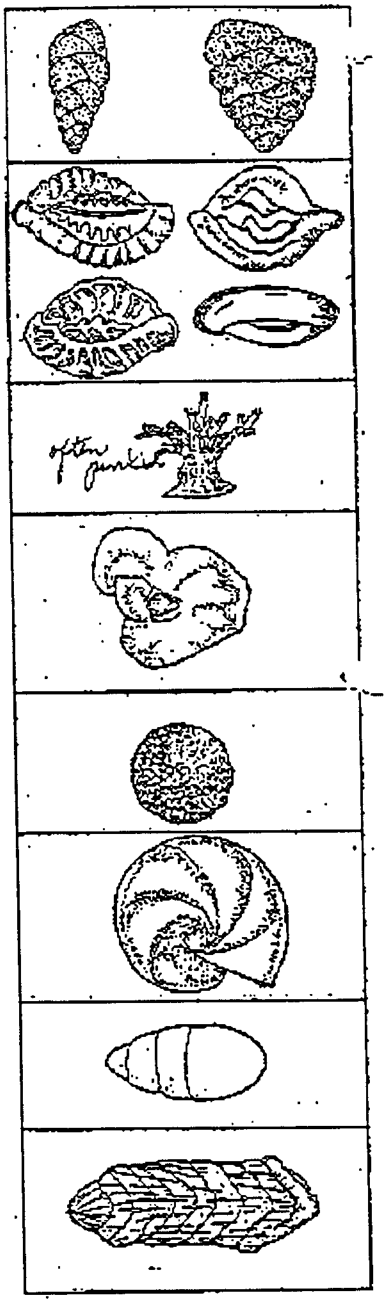
Submarine canyon: The deep gorge residing underwater and formed by the underwater extensions of rivers.

Terrigenous: Sediments deposited from land to the sea floor.

Turbidity current: An undersea landslide causes the sediment caught up in the flow to intermix and stratify into a characteristic gradation pattern of coarse to fine-grained particles that flow over very gentle slopes for many hundreds of miles as a sea floor current.

Weathering: The erosion of the continent or the high ground below sea level.

Key To Forams



<u>Textularia</u> sp.
Composed of very fine agglutinated sand grains.

<u>Quinqueloculina</u> sp.
Five chambers, vary in appearance

<u>Homotrema</u> sp.
Resembles small coral head. Pure white to deep rose in color.

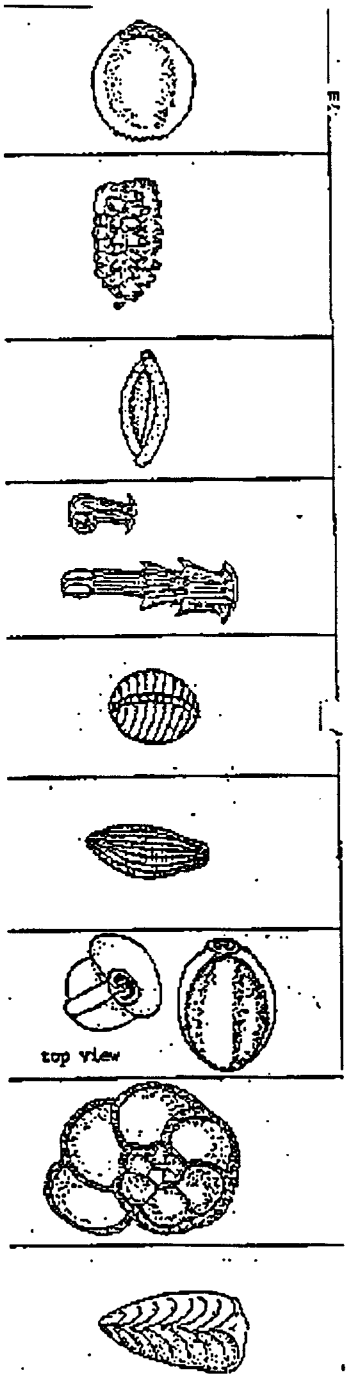
<u>Parrina</u> sp.
Bubble-like chambers. Bright orange colored opening.

<u>Sphaerogypsina</u> sp.
Large hollow globe shaped and tan.

<u>Robulus</u> sp.
Large, nautilus shaped.

<u>Lingulina</u> sp.
Beetle shaped, white and shiny.

<u>Frondicularia</u> sp.
Large, flat, blade-like shape. Chevron shaped chambers. Found in deep samples.



Pyrgo sp.
Small, shiny and oval with unusual opening

Gudyrina sp.
Corncob shaped, with tube-like extensions in vertical rows or spiraled.

Schlumbergerina sp.
Look eroded usually, tear-drop shape.

Articulina sp.
Unique chambers, make it easily broken.

Borelis sp.
Small round with encircling lines.

Alveolinella sp.
Unique unusual shape.

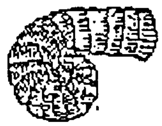
Triloculina sp.
Unusual aperture, plump oval shape.

Globorotalia sp.
Usually clear, each chamber curved on top.

Chrysalidinella sp.
Triangular tests, numerous walls

Tretomphalus sp.
Thin, globe-like capped with "flower"

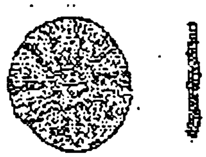
Cybaloporetta sp.
Flower-like upper side, with chambers arranged in circular pattern.



Spirolina sp.
"Ram's Horn", unique shape and chambers.

Spiroloculina sp.
Unique test with chambers added on either side.

Globigerina sp.
Planktonic forams, with bubble-like chambers.

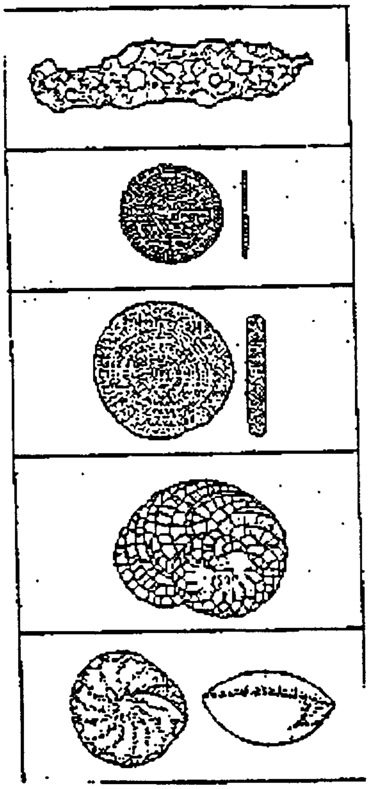


Amphisorus sp.
Thin disc, with rings of chambers randomly dispersed.

Peneroplis sp.
Fan-shaped, with long curved chambers.

Dentalina sp.
Long, curved, shiny, foram.

Nodosaria sp.
Long, and tapered rod-like forams that are blunt and tapered.



Rheophax sp.
Long, odd-shaped, glutinated sand grains

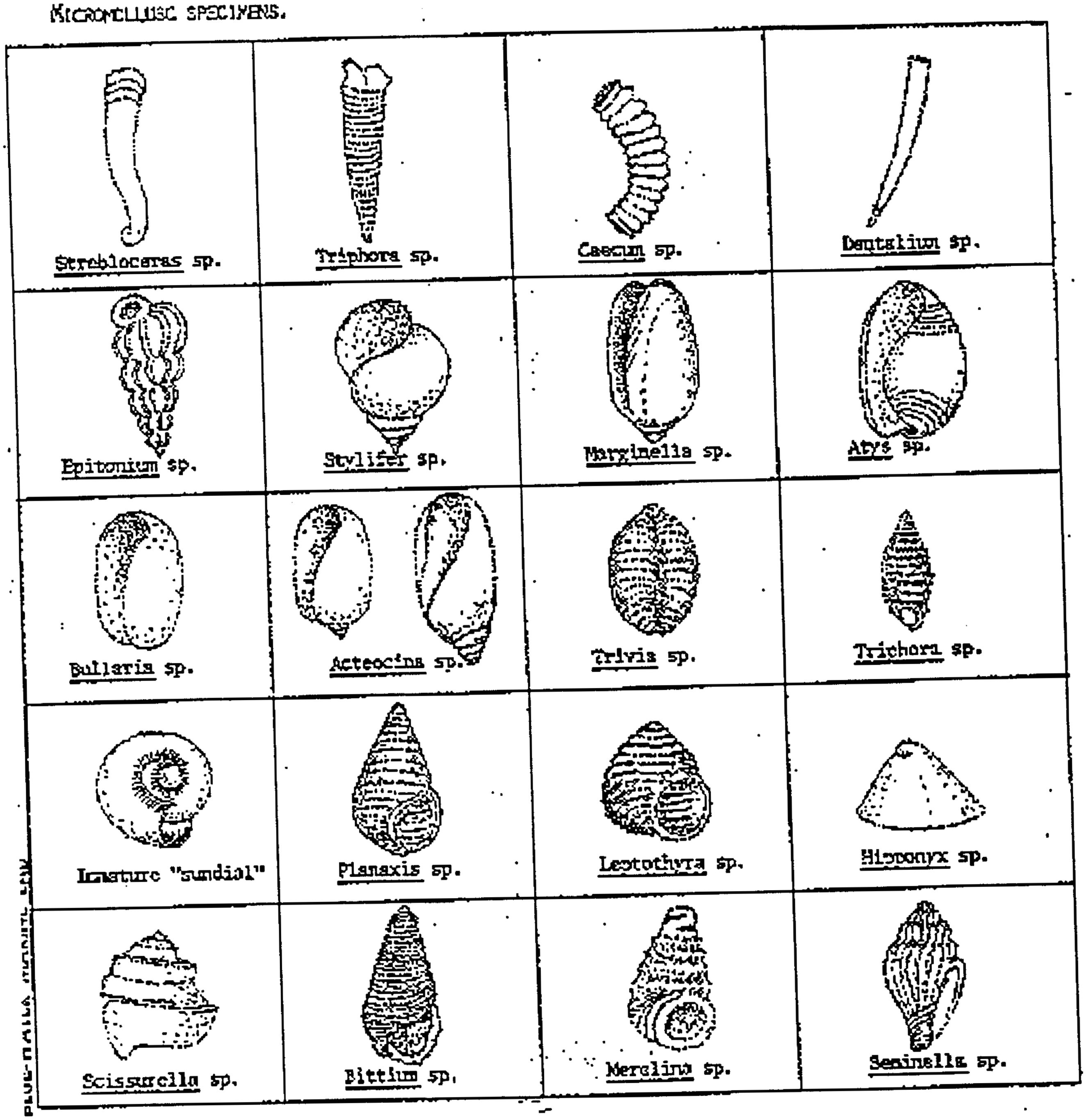
Sorites sp.
Extremely thin flat disc with alternating colored rings

Marginopora sp.
Thick, disc known as "papershell"

Heterostegina sp.
Largest species with rounded inner portion surrounded by thin veined flange of chambers

Amphistegina sp.
Most abundant in Hawaii, with brownish tissue indicating animal life.

MICROMOLLUSC SPECIMENS.



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